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**THE METHOD OF PROGRESSION IN TRUNCATELLA.**

BY HENRY A. PILSBRY AND AMOS P. BROWN.

Early in August of 1913, when one of us (Brown) was collecting fossils along the shores of Willoughby Bay, Antigua, upon turning over a piece of limestone a few feet above high-water mark, he came across a colony of *Truncatella bilabiata* Pfr. They were very plentiful under the slab, and those that were not disturbed by the lifting of the stone were seen to be in motion. Others at once retracted the body into the shell along with the operculum and assumed the appearance of dead shells. On observing those that continued to move it was at once noticed that they do not employ the same method as the rapidly moving *Colobostylus* and *Tudora* already observed in Jamaica, nor that of the *Cistula* observed in Antigua, but seem to adopt the method of the "measuring worm" in their progression. A number of the shells with the living animal were collected in a specimen bottle, and upon returning to the town of St. John's they were kept under observation for some time. In fact, upon returning to Philadelphia some weeks later, most of them were still quite lively and moved about actively. It was from these survivors that the figures were drawn. Before leaving St. John's, notes upon the method of motion were made. These observations were repeated in Philadelphia.

When disturbed or startled, the animal at once withdraws into the shell and closes the opening by the operculum, which in fact is drawn in beyond the lip. They then resemble pieces of stone or fragments of dead leaves, and without close observation they would escape notice. After they are left to themselves for a short time, the animal protrudes the operculum, with the foot and proboscis, which latter at once begins to feel about until it encounters some firm substance, when the foot is fully protruded. The foot is a squarish pad of about 1 square millimeter in area. The proboscis may be extended to  $1\frac{1}{2}$  mm. or more. It is waved to and fro until it encounters the surface over which the animal moves, bending downward at the same time and presenting in front view a certain ludicrous resemblance to the head of a moose, which resemblance is enhanced by the blunt expanded snout of the proboscis and by the

tentacles, which are in the position of the ears of the moose. The foot, when fully protruded, is attached firmly to the surface moved over; the proboscis is then raised and waved about again, and crawling commences. The progression begins by a stretching forward of the proboscis, its tip is then applied to the surface moved over, and this tip flattens out until nearly the size of the foot. If the proboscis secures a firm attachment, the foot may now be released, and either drawn up to the attached proboscis by sliding the edge of the foot along the surface, or the entire animal may be supported upon the proboscis and the foot raised clear of the surface and drawn up to the proboscis, when its edge will rest on the surface moved over. Perhaps more often the foot is raised anteriorly and slid forward upon its posterior edge up to the attached proboscis; the position assumed by the body of the animal being now the same as when it is retracted into the shell. Starting from this position, the method of progression may be described as follows: The square pad of the foot is turned down anteriorly until it is firmly attached to the surface moved over, simultaneously the attachment of the proboscis is released and this is moved to find another attachment; as soon as this is found the firm attachment of the proboscis is effected again; then the entire shell is hitched forward as the foot is lifted and brought up in contact with the under side of the proboscis. In case the foot is lifted clear of the surface moved over, the posterior edge of the foot touches the surface first; if not lifted clear of the ground, this edge is slid or dragged over the surface until the foot comes up to the under side of the proboscis. Its posterior edge is then applied to the ground, and, as the proboscis is loosened and raised, the foot turns down until it is firmly in contact with the ground, and the waving about of the proboscis and its final attachment proceeds as before.

The entire cycle of movements comprising the "step" is executed in four seconds or less, so that the animal will make 15 to 17 "steps" in a minute when advancing steadily in one direction; and in these 15 to 17 "steps" it will have moved over 20 to 25 mm. of surface. But it frequently happens that the proboscis does not secure a firm attachment, and, when the step is attempted, the proboscis slides back to the foot and the body is not advanced at all. The proboscis is then raised and waved about, another "step" is attempted, and generally succeeds. The animal may thus move forward in a straight line or it may take quite an erratic course. The shell sometimes rests upon the operculum, sometimes it is simply dragged

along the ground; and it is jerked forward when the foot is raised, sometimes supported upon the operculum, but quite as often not. The muscles controlling the movement of the foot and of the proboscis can evidently act quite independently of each other.

The external soft parts of *T. bilabiata* are very pale cartridge buff. There is an ill-defined, flesh-tinted spot on the proboscis, caused by some colored body, perhaps the radula and its sack, shining through. The proboscis has faint annular wrinkles.

Compared with other land operculate snails we have seen alive, *Truncatella* is remarkable for the small size of the foot and the extraordinary development of the proboscis.

The terrestrial prosobranch gastropods show a good deal of diversity in dealing with the problem of progression on a dry surface. The *Cyclophoridae* glide, like aquatic tænioglossate forms. The *Ericiidae* move by the forward translation of vertical folds, alternating on the two sides of the foot, while the *Truncatellidae* step. The gait of *Pomatiopsis lapidaria* is intermediate between the step and the glide, and serves to show how the gait of *Truncatella* was probably evolved. The proboscis and oral disk are used exactly as in *Truncatella*, but the foot moves by gliding or sliding, first the fore part moving forward to the proboscis, then the back part.

#### EXPLANATION OF PLATE XIV.

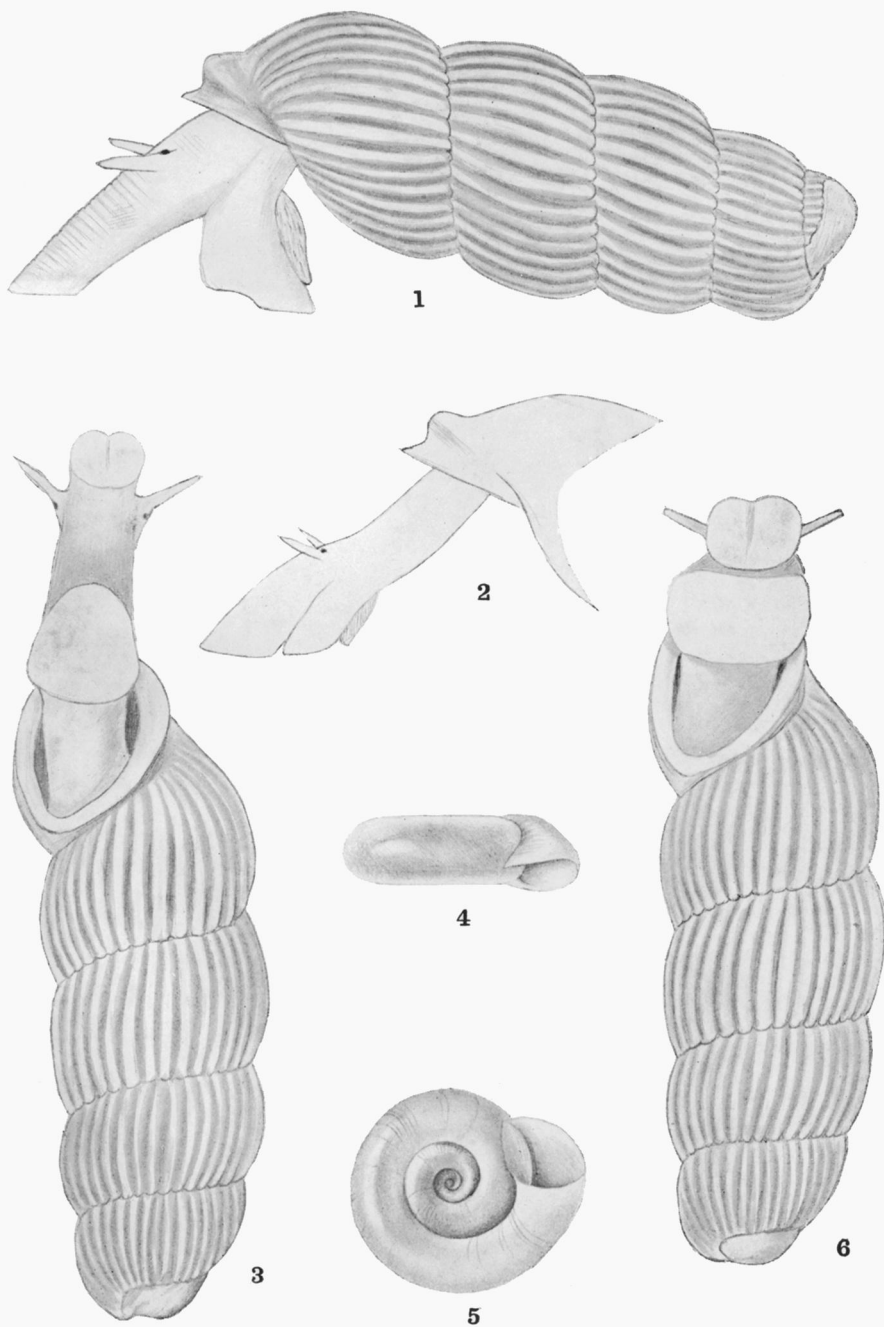
Fig. 1.—*Truncatella bilabiata*. Proboscis and foot both in contact with ground, the front part of foot being raised preparatory to forward movement.

Fig. 2.—Near the end of the forward step of the foot, the shell trailing far behind.

Fig. 3.—End of the forward step of proboscis, the shell trailing far in the rear. This position is slightly anterior to that shown in fig. 1.

Figs. 4, 5.—*Segmentina obstructa geoscopus*, n. subsp.

Fig. 6.—*Truncatella bilabiata*. End of forward step of the foot, the shell pulled forward. This position is slightly later than that shown in fig. 2.



PILSBRY AND BROWN: PROGRESSION OF TRUNCATELLA.